From: Kornder, Steve [mailto:Steve.Kornder@aecom.com]
Sent: Monday, April 20, 2015 8:51 PM
To: Simon, Verneta; Jablonowski, Eugene; Martwick, Cathleen; Fulghum, Mary
Cc: Daniel Blondin (DBlondin@navypier.com); Steve Haemmerle (shaemmerle@navypier.com); Keith Johnston (Keith.Johnston@mckissackdc.com); Tom Conroy (tconroy@mchughconstruction.com); 'Lyons, Francis' (FLyons@schiffhardin.com); Kennedy, Matthew (Chicago); Schmidt, Brian
Subject: Navy Pier - Gamma Spec Results for Sample Collected April 17, 2015

Good Evening:

I have attached the results for the sample I collected on Friday afternoon from beneath the sidewalk subgrade on the west side of Headhouse Road (southwest corner of construction area). I delivered the sample to RSSI this morning. The sample was mostly dark brown to black in color, but contained some reddish orange ash layers that contained the ceramic mantle pieces as well as several apparent asbestos mantle string ties. Based on gamma readings, the sample was collected from the top of the layer of apparently thorium contaminated soil. It likely does not represent the most contaminated portion of the fill soil present since the readings at this layer were approximately 300,000 cpm. However, the attached results indicate a radium-228 activity of 11.7 pCi/g and a radium-226 activity of approximately 0.7 pCi/g. Thus, the elevated radium-228 activity is consistent with thorium contamination as well as being well above the USEPA cleanup value of 7.1 pCi/g for total radium.

Please let us know if you have any questions regarding this sample or a desire to have this sample submitted to a USEPA contract laboratory.

Sincerely,

Steve Kornder, Ph.D.

Senior Project Geochemist

C 262.515.7700 (New Cell Number)

AECOM

303 E. Wacker Drive, Suite 1400

Chicago, IL 60601

steve.kornder@aecom.com

RSSI

6312 West Oakton Street
Morton Grove, IL 60053-2723
847-965-1999
Fax 847-965-1991

Monday, April 20, 2015

Steve Kornder
AECOM
303 E. Wacker Dr.
Suite 1400
Chicago, IL 60601

RE: HHRI (Bulk Soil)

Dear Mr. Kornder:

A summary of gamma spectroscopy results for our sample number G150042 is in Table 1. AECOM identified the sample as HHRIG-3 (Bulk Soil). The table below lists the concentrations of selected radionuclides. Values with a less-than symbol ("<") indicate a concentration below RSSI's minimum detectable concentration (MDC). Other identified radionuclides are in the complete gamma spectroscopy report.

Table 1. High-resolution Gamma Spectroscopy Results [pCi/g]

Radionuclide	Sample
	G150042
	HHRI (Bulk Soil)
Pb-214	0.8
Bi-214	0.7
Ra-226[1]	0.8
Ac-228	11.7
Ra-228[2]	11.7
Th-232[3]	11.7
Tl-208	3.4
K-40	8.7
Pb-212	11.6
Bi-212	12.6
Th-228	< 2.5

[1] The concentration of Ra-226 is based on the surrogates Pb-214 and Bi-214.
[2] The concentration of Ra-228 is based on the surrogate Ac-228.
[3] The concentration of Th-232 is based on the surrogate Ac-228.

Some radionuclides of interest, thorium-232 (Th-232), radium-226 (Ra-226), and radium-228 (Ra-228), are difficult to identify and quantify directly at low concentrations with reasonable counting

intervals. The concentrations of surrogates with more abundant high energy photons usually represent the concentration of Th-232, Ra-226, and Ra-228. The successful use of surrogates depends upon the radionuclides in each series being in equilibrium.

Ra-226, in the uranium series, has only one significant photon at 186.21 keV with a gamma fraction slightly greater than 0.03. Analysis for Ra-226 using this energy is difficult because of the possible presence of uranium-235 (U-235), which has an interfering 185.72 keV photon with a 0.57 gamma fraction, and protactinium-234 (Pa-234) which emits an interfering 186.15 keV photon with a 0.02 gamma fraction. Bismuth-214 (Bi-214) and lead-214 (Pb-214), in the uranium series, may be used as surrogates for Ra-226 when these radionuclides are in equilibrium. Gamma fraction is the fraction of decays that produce a photon of a given energy.

The equilibrium between Ra-226 and its surrogates may be disturbed when samples are collected; radon-222 (Rn-222), a short-lived (half-life of 3.8 days) gaseous Ra-226 decay product, can be released. Pb-214 and Bi-214 return to equilibrium with Ra-226 in a sample after an ingrowth period. Equilibrium is reestablished within seven half-lives of Rn-222. In standard protocols, samples are held for a 30-day ingrowth period to reestablish equilibrium. These samples were not held for an in-growth period of at least 30 days.

Both Th-232 and Ra-228, in the thorium series, emit photons with very low gamma fractions at very low energies. In the thorium series, actinium-228 (Ac-228) is usually in equilibrium with both Th-232 and Ra-228 when collected.

The complete spectroscopy analysis results are attached. Please call me at 847-965-1999 if you have any questions.

Sincerely,

Aaron D. Morris

Aaron Morris

attachment

ORTEC g v - i (1215) Env32 G53W4.22 20-APR-2015 17:28:18
RSSI Spectrum name: G150042.An1

Sample description
G150042 AECOM, HHRI, 785.7 g

Spectrum Filename: H:\GammaVision\User\Spectra\G150042.An1

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****

Nuclide		Activity uCi/g	Time of Count Uncertainty Counting	1 Sigma Total
PB-214		7.9487E-07	8.356E+00%	8.713E+00%
PB-212		1.1603E-05	1.076E+00%	3.157E+00%
BI-212		1.2553E-05	4.476E+00%	5.012E+00%
AC-228		1.1684E-05	1.850E+00%	2.834E+00%
Tl-210	<	2.0372E-08		
TL-208		3.4386E-06	1.809E+00%	2.911E+00%
K-40		8.7032E-06	4.302E+00%	5.489E+00%
BI-214		7.4788E-07	1.078E+01%	1.102E+01%
PB-210	<	1.6741E-05		
Th-228	<	2.5292E-06		

< - MDA value printed.
A - Activity printed, but activity < MDA.
B - Activity < MDA and failed test.
C - Area < Critical level.
F - Failed fraction or key line test.
H - Halflife limit exceeded

---------- S U M M A R Y ----------

Total Activity (1120.2 to 1749.7 keV) 4.952E-05 uCi/g
This section based on library: AECOM - 2015-01.Lib

Sample description
G150042 AECOM, HHRI, 785.7 g

Spectrum Filename: H:\GammaVision\User\Spectra\G150042.An1

***** S U M M A R Y O F L I B R A R Y P E A K U S A G E *****

Nuclide Name	Code	Average Activity uCi/g	Peak Energy keV	Peak Activity uCi/g	Code	Peak MDA Value uCi/g	COMMENTS
PB-214	N	7.9487E-07					
			351.93	7.774E-07	?(	5.347E-08 1.21E+01	G
			295.22	8.286E-07	(	8.982E-08 1.15E+01	G
			77.11	0.000E+00		4.227E-09 0.00E+00	XA
			241.99	0.000E+00		3.196E-09 0.00E+00	G
			74.82	0.000E+00		7.760E-09 0.00E+00	XA
PB-212	N	1.1603E-05					
			238.63	1.163E-05	@(	5.525E-08 1.08E+00	G
			300.09	1.127E-05	(	5.086E-07 5.23E+00	G
BI-212	N	1.2553E-05					
			727.33	1.255E-05	(	3.054E-07 4.48E+00	G
			1620.50	1.626E-05	+	2.000E-06 1.47E+01	G
			785.37	2.407E-05	+	2.448E-06 1.68E+01	G
			893.41	2.110E-05	+	4.083E-06 2.35E+01	G
AC-228	N	1.1684E-05					
			911.20	1.183E-05	(	6.412E-08 1.85E+00	G
			968.97	1.176E-05	(	1.537E-07 2.37E+00	G
			338.32	1.136E-05	(	1.735E-07 2.92E+00	G
			964.77	1.139E-05	(	7.848E-07 7.71E+00	G
			463.00	1.267E-05	+	6.526E-07 8.19E+00	G
Tl-210	N	0.0000E+00					
			298.00	0.000E+00	&	2.037E-08 1.00E+03	G
			799.60	0.000E+00	&	1.504E-08 1.00E+03	G
			1210.00	0.000E+00	%	1.019E-07 1.00E+03	G
			1070.00	0.000E+00	%	6.341E-08 1.00E+03	G
			1316.00	0.000E+00	%	2.732E-08 1.00E+03	G
TL-208	N	3.4386E-06					
			583.19	3.439E-06	(P	2.567E-08 1.80E+00	G
			510.77	4.136E-06	+	1.564E-07 4.93E+00	G
			860.58	4.196E-06	+	2.412E-07 6.09E+00	G
			277.37	4.863E-06	+	3.439E-07 1.43E+01	G
			763.13	4.227E-06	+	1.119E-06 2.45E+01	G
K-40	N	8.7032E-06					
			1460.82	8.703E-06	(P	2.136E-07 3.58E+00	G
BI-214	N	7.4788E-07					
			609.32	7.479E-07	(P	4.108E-08 1.01E+01	G
			1764.49	0.000E+00	=	0.000E+00 0.00E+00	G
			1120.29	1.286E-06	+ P	1.596E-07 1.66E+01	G
			1238.12	1.001E-06	+ P	3.162E-07 3.69E+01	G
			768.36	4.320E-07	-	3.498E-07 7.78E+01	G
I-129		0.0000E+00					
			39.58	0.000E+00		0.000E+00 0.00E+00	G
			34.42	0.000E+00		0.000E+00 0.00E+00	X
			33.62	0.000E+00		0.000E+00 0.00E+00	X
			33.56	0.000E+00		0.000E+00 0.00E+00	X
			29.78	0.000E+00		0.000E+00 0.00E+00	X

Sample description
G150042 AECOM, HHRI, 785.7 g

Spectrum Filename: H:\GammaVision\User\Spectra\G150042.An1

		29.46	0.000E+00		0.000E+00	0.00E+00	X
PB-210	N	0.0000E+00					
		46.54	0.000E+00	%	1.674E-05	1.00E+03	G
Th-228	N	0.0000E+00					
		84.37	0.000E+00	%	2.529E-06	1.00E+03	G
		215.98	0.000E+00	%	7.868E-06	1.00E+03	G
		166.41	0.000E+00	&	1.807E-05	1.00E+03	G
		205.93	0.000E+00	&	7.834E-05	1.00E+03	G

(- This peak used in the nuclide activity average.

* - Peak is too wide, but only one peak in library.
! - Peak is part of a multiplet and this area went
    negative during deconvolution.
? - Peak is too narrow.
@ - Peak is too wide at FW25M, but ok at FWHM.
% - Peak fails sensitivity test.
$ - Peak identified, but first peak of this nuclide
    failed one or more qualification tests.
+ - Peak activity higher than counting uncertainty range.
- - Peak activity lower than counting uncertainty range.
= - Peak outside analysis energy range.
& - Calculated peak centroid is not close enough to the
    library energy centroid for positive identification.
P - Peakbackground subtraction
} - Peak is too close to another for the activity
    to be found directly.

Nuclide Codes:	Peak Codes:
T - Thermal Neutron Activation	G - Gamma Ray
F - Fast Neutron Activation	X - X-Ray
I - Fission Product	P - Positron Decay
N - Naturally Occurring Isotope	S - Single-Escape
P - Photon Reaction	D - Double-Escape
C - Charged Particle Reaction	K - Key Line
M - No MDA Calculation	A - Not in Average
R - Coincidence Corrected	C - Coincidence Peak
H - Halflife limit exceeded	

- -
This section based on library: AECOM - 2015-01.Lib

ORTEC g v - i (1215) Env32 G53W4.22 20-APR-2015 17:28:18
RSSI Spectrum name: G150042.An1

Sample description
G150042 AECOM, HHRI, 785.7 g

Spectrum Filename: H:\GammaVision\User\Spectra\G150042.An1

********** U N I D E N T I F I E D P E A K S U M M A R Y **********

Peak Channel	Centroid Energy	Background Counts	Net Area Counts	Intensity Cts/Sec	Uncert 1 Sigma %	FWHM keV		Suspected Nuclide
130.47	26.20	10465.	23056.	6.404	1.33	4.532	-	sM
190.83	39.17	5462.	1284.	0.357	12.19	1.709	-	sM
362.04	75.95	9080.	7231.	2.009	3.71	4.267	-	sM
400.27	84.17	4356.	157.	0.044	91.16	0.598	-	sM
901.54	191.89	3707.	542.	0.151	32.56	0.382	-	s
933.80	198.90	2845.	203.	0.056	37.79	2.311	-	D
959.54	204.43	4691.	336.	0.093	29.35	2.312	-	D
982.73	209.42	3922.	1949.	0.541	5.08	2.313	-	D
1265.94	270.21	2517.	1386.	0.385	9.00	1.948	-	M
1535.04	328.05	2675.	1075.	0.299	12.08	1.772	-	s
2505.57	536.68	204.	64.	0.018	39.26	0.504	-	s
2539.07	543.88	328.	51.	0.014	58.95	0.443	-	s
2587.33	554.25	706.	165.	0.046	38.46	0.395	-	s

s - Peak fails shape tests.
D - Peak area deconvoluted.
L - Peak written from unknown list.
C - Area < Critical level.
M - Peak is close to a library peak.

This section based on library: AECOM - 2015-01.Lib

```
     ORTEC g v - i (1215) Env32  G53W4.22  20-APR-2015 17:28:18
RSSI                              Spectrum name: G150042.An1

Sample description
     G150042 AECOM, HHRI, 785.7 g

Spectrum Filename: H:\GammaVision\User\Spectra\G150042.An1
Acquisition information
       Start time:                20-Apr-2015 15:04:10
       Live time:              3600
       Real time:              3619
       Dead time:                 0.53 %
       Detector ID:                  3

Detector system
     CLTCOMP MCB 9

Calibration
       Filename:                  2015-04-20 DEC, 30%, v. 9.Spc
     2015-03-13 30% GEM-30185-P Calibration

       Energy Calibration
            Created:              20-Apr-2015 17:25:40
            Zero offset:         -1.837 keV
            Gain:                 0.215 keV/channel
            Quadratic:            2.543E-08 keV/channel^2

       Efficiency Calibration
            Created:              13-Mar-2015 09:43:41
            Type:                 Polynomial
            Uncertainty:          1.183 %
            Coefficients:        -0.565298  -4.206668   0.446344
                                 -0.045674   0.001367  -0.000021

Library Files
       Main analysis library:     AECOM - 2015-01.Lib
       Library Match Width:       0.500
       Peak stripping:            Library based

Analysis parameters
       Analysis engine:           Env32   G53W4.22
       Start channel:            20 (     2.46keV )
       Stop channel:           8144 (  1749.69keV )
       Peak rejection level:    100.000%
       Peak search sensitivity:   3
       Sample Size:               7.8570E+02
       Activity scaling factor:   1.0000E+00/(  1.0000E+00*  7.8570E+02) =
                                  1.2728E-03
       Detection limit method:    Traditional ORTEC method
       Random error:              1.0000000E+00
       Systematic error:          1.0000000E+00
       Fraction Limit:            0.000%
       Background width:          best method (based on spectrum).
       Half lives decay limit:   12.000
       Activity range factor:     2.000
       Min. step backg. energy    0.000
       Multiplet shift channel    2.000

Corrections                         Status          Comments
       Decay correct to date:        NO
       Decay during acquisition:     NO
       Decay during collection:      NO
       True coincidence correction:  NO
       Peaked background correction: YES       2014-10-09-10 Background, 30%, G
                                               10-Oct-2014 12:56:45
       Absorption (Internal):        NO
       Geometry correction:          NO
       Random summing:               NO

total peaks alloc.     30  cutoff   20.00000     %
       Energy Calibration
            Normalized diff:      0.1329
```